

## THEORY AND PRACTICE OF CRUSHING, SEPARATION, MIXING AND COMPACTION PROCESSES (Results of the Vth International Conference)

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The introduction of advanced effective technologies for crushing, separating, mixing, and compacting in the ceramic and other industries is of great practical importance. The Vth international conference devoted to these problems was held, like the previous ones, in the Belgorod-Dnestrovsky District of the Odessa Region in 1997. The results obtained in the discussed field by various scientific schools of the CIS countries were presented. The conference was attended by representatives of scientific schools and mining and processing enterprises in Odessa, Dnepropetrovsk, Kharkov, Kiev, Donetsk, Krivoy Rog, Minsk, Kishinev, St. Petersburg, Ekaterinburg.

The organizers of the conference were the Odessa State Marine Academy (department of higher mathematics), the Kharkov State Polytechnical Institute (department of technology of ceramics, refractories, glass and enamels), and the National Mining Academy of Ukraine (department of mining machines) engaged in the scientific programs of the Ministry of Defense of Ukraine, including problems of low-temperature synthesis of refractory compounds.

A review by I. I. Blekhman (St. Petersburg) was devoted to methods of testing mechanical systems subjected to vibration, the changes in their mechanical and rheological properties, and the use of effects established in practice in order to improve compaction of ceramic mixtures on various binders.

G. A. Saipiev (Ekaterinburg) described his new method for disintegrating solid particles, i.e., resonance disintegration with the use of hydroquantum resonators, which provides for a very efficient crushing process. The results on crushing various materials in apparatuses based on the described principles show the efficiency of the method and its prospects for the science of ceramic materials.

The report of L. Zh. Gorobets, A. I. Lyuty, and S. B. Dubrova (Dnepropetrovsk, Donetsk) was devoted to the relations between the parameters of dispersed solid bodies and the thermodynamic characteristics of the critical state of a substance. The scientists continue to develop the method considered at the previous two conferences and study the threshold state of the substance that corresponds to the beginning of dispersion from the standpoint of thermodynamics with involvement of the fundamental individual characteristics of the substance parameters, i.e., the pressure, temperature, spe-

cific volume, melting and evaporation temperatures, and energies of phase transformations. They demonstrated the possibility of predicting the energy capacity of dispersion of various kinds of ceramic and chemical raw materials from the specified parameters.

The use of mechanochemical processes for synthesizing specified phases substantially widens the possibilities of creating new materials; this explains the growing interest in these methods in the science of ceramic materials. The report of G. D. Semchenko, E. E. Starolat, I. N. Opryshko, and L. A. Andropova (Kharkov) was devoted to the mechanochemical processes that occur in milling oxygen-free fillers and sintering additives with silicon alkoxide; the authors defined the mechanochemical synthesis of silicon oxynitride, mullite, SiC and suggested methods for preparing batch components with the use of elements of the sol-gel process, which provided for creation of composite materials based on refractory oxygen-free fillers with high physicomechanical characteristics, in particular, using powdered silicon and boron carbides with a crack resistance of at least  $6.5 \text{ MPa} \cdot \text{m}^{0.5}$ .

V. I. Sivko, I. P. Nesterenko, and V. V. Kiryushchenkova (Kiev) reported the results of a theoretical study of gyration vibration of machines used for vibrocompaction of concrete mixtures. They obtained formulas for calculating the rebalance mass of a vibrator providing for the given amplitude. In the second report, V. I. Sivko and E. A. Skubak (Kiev) considered the problems of use of flexible functional organs in vibration machines. They obtained frequency spectra corresponding to various kinds of vibration of the plates of the functional organs and determined the amplitudes at the critical points. V. I. Sivko and A. A. Tarkutsyaka (Kiev) devoted their report to corrosion protection of the functional surfaces of construction machines. They presented the results of a study aimed at determining the strength of the adhesive bond between concrete mixtures of various compositions and polymer coats of the functional surfaces of construction machines. The study was conducted on a specially designed experimental installation. The results make it possible to create more efficient vibration equipment.

The reports of V. I. Nitsenko, V. V. Saposhko, and I. A. Bragadnaya (Minsk) were devoted to the operation of ventilation circuits combining the processes of milling, classification and dedusting. In contrast to the acting milling units, these circuits provide more accurately provide for the requisite dispersion of the milled product, make it possible to shorten pre-

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paratory milling, and thus increase the efficiency of the system as a whole. The authors suggested a method for evaluating the strength of mineral raw materials and their components from their milling kinetics in such circuits in an overload regime.

The series of reports by A. I. Egurnov, V. P. Ravishin, and N. I. Sokur (Dnepropetrovsk, Krivoy Rog) presented the results of a study of the efficiency of use of elastic screening surfaces developed by the authors for classifiers of milled materials. The rapid wear of metallic screens on grizzlies in classifying crushed natural raw materials leads to great expenses. The authors developed new low-wear screens with narrow limits of the removed fractions of crushed material. The separators for production of the screens employ a very effective flexible material, which reduces their wear substantially and simplifies replacement of worn-out regions, because the surfaces of the classifier are made of individual modules. The results of introduction of the invention in one of the mining enterprises showed a marked reduction in the consumption of materials and the cost of the separators, and improvement of the quality and rate of separation for crushed raw materials of various hardnesses. The data on the use of elastic trommels in mills show that it is possible to eliminate the apparatuses for subsequent classification from the process chain. The inventions are being installed in mining enterprises.

S. N. Daineko and S. G. Azizbekyan (Minsk) presented designs for various apparatuses for crushing and separating with the use of cast polyurethane compositions which increase the inter-repair period of the machines and their operational reliability.

Some reports were devoted to theoretical investigations of the milling processes in various devices. For example, M. N. Trubitsyn (Dnepropetrovsk) described the introduction of internal feeding of a tube mill operating in the waterfall mode and gave a theoretical determination of the useful power and torque of the engine of the turbine in the mill using the derived equations. The results of the study agree with the experimental data and make it possible to control the efficiency of operation of the tube mill with respect to the power consumed by its engine. A. F. Krivoy (Odessa) suggested a new approach to the determination of the efficiency of milling devices on the basis of pulsed fracture. The criterion was generalized to the case of inhomogeneity of the properties of the milled material.

A series of works by N. I. Sokur was devoted to the devices developed by him for continuous control of the proc-

esses of crushing and milling with the use of radioisotope and ultrasound methods for controlling the parameters of the raw materials. The system was created and has been widely installed in enterprises of the mining industry.

The report of A. V. Antsiferov, V. N. Zhilkin, and A. A. Titov (Dnepropetrovsk) was devoted to a study of feeding of a vertical vibration mill; an experimental installation was created for testing the obtained results and the limits of application of the suggested model were studied. The method makes it possible to determine the optimum parameters of the operating regime of a vertical vibration mill for solid bodies.

P. P. Krivoruchko, N. L. P'yanykh, and E. A. Denisenko (Kharkov) studied milling of various kinds of alumina for the production of corundum ceramics and presented the comparative results of experiments on preparing alumina in domestic and foreign vibration mills with a study of the milling kinetics and the effect of the vibration milling parameters on the characteristics of sintered articles. The effect of various equipment on milling of alumina raw materials and on their sintering was studied.

V. P. Ovchinnikov (Odessa) presented "Mathematical models of the activation process." The suggested model is assumed to cover all kinds of activation, for example, biological, psychic, mechanical, mechanochemical. Activation is understood as a logical quantity possessing inertia and a finite or infinite number of degrees of freedom. In the one-dimensional case, activation is described by a time function alone. The forces that cause activation are classified into three groups, namely, the principal force allowing for the history of the activated mixture, the running force worked out in the course of activation, and the action of the environment. The equation describing activation has the form of an analog of Newton's second law or of a system of ordinary second-order differential equations. The equations describing the activation process are derived by analogy with the diffusion equations.

The level of reports presented at the conference was very high. Its results will promote the development of the theoretical foundations of processes of milling, separation, mixing and compaction and improve the methods of their use not only in the ceramic and mining industries but in other branches too.

The organizers of the conference are interested in widening the circle of representatives of various scientific schools and invite all specialists interested in the introduction of advanced technologies in industry.